The genesis of the Kurišková U-Mo ore deposit

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Regarding the *regional geology,* the U-Mo ores of Kurišková deposit, which is a well-known uranium deposit in Slovakia, are placed within the Huty Volcanogenic Complex of the Lower Permian age. It belongs to the Petrova hora Formation and tectonically corresponds to the Permian in the North-Gemeric zone of the Western Carpathians.

Lithologically, the Huty Volcanogenic Complex (HVC) is built up by the volcanic rocks of bimodal basalt-rhyolite association, intercalated with sandstones, mudstones and claystones. Compositionally, the basic volcanic rocks represent the primitive undifferentiated subalkaline basalts and basaltic andesites. They are a product of effusive and explosive eruptions, linked to the geodynamic setting of a convergent plate margin.

The *chemistry of acid volcanics* shows dacitic and rhyolitic peraluminous composition of a high potassium magma differentiation series. Both extrusive and explosive types were identified in the HVC. Based on the sedimentary facies reconstruction, it is supposed that the sandstone and siltstone sheets alternating with mudstones and claystones represent sediments of seasonally flooded shallow lakes. The paleoenvironmental conditions of this sedimentary association are assumed to be those of a continental fluvial plain facies. There is a transition to estuaries and shallow marine facies of continental shelf in the upper part of HVC (as evidenced by the presence of phosphate nodules and evaporites).

The thermal history of *metamorphic overprint* was reconstructed on the basis of clay mineralogy, using X-ray powder diffraction methods. It reveals peak condition of 350 °C ($2M_1$ illite/muscovite) of epizonal regional metamorphism, followed by exhumation to conditions of ~200 °C (1M illite, mixed-layered illite-smectite). The temperature decrease and resetting of previous higher thermal conditions have occurred during tectonic uplift of buried HVC along with the hydrothermal alteration by permeating hot water (≤200 °C).

Concerning *the space relationship of U-Mo mineralization and host rock,* the main ore forming minerals are uraninite, coffinite and molybdenite. They occur in various metasedimentary and metavolcanic rock types of HVC, especially on the contact with the surface of basaltic body. Mineralization is disseminated along sedimentary structures and tectonically driven fractures in both main rock types. In many cases, contemporaneous deformation of uranium mineralization, together with the straight deposition of a new uranium ores is present. Some of the molybdenite-rich subvertical faults are likely to be the remnants of the original primary structures transporting mineralized waters into the deposit space.

Geochemistry of U-Mo deposit shows special ratio of Th/U << 1 which is a significant deviation from the average Th/U 2–3 for rhyolite rocks as proposed by Nash et al. (2010). Other important geochemical data show strong correlation between U, P ($r > 0.9$) and Pb and only weak correlation with Mo ($r \leq 0.6$). This suggests common geochemical history of U-P-Pb and separation of U-Mo during deposit forming processes.

Ages of U-Mo deposit: The geochronological dating, using Th-Pb electron microprobe method applied robustly to uraninite crystals, provided ages of the main ore forming processes within interval of 200–160 Ma. Surprisingly, this corresponds to the Triassic/Jurassic boundary, which coincides with significant climate change from arid to humid conditions. Consequent uranium remobilization and ore maturation is dated to 150–50 Ma and 40–10 Ma. However, these modification processes were active only within limited scale.

Origin of the Kurišková U-Mo ore deposit: The deposit consists of three ore bodies of a tabular shape. The main ore body is spatially closely linked to mylonitized metabasalt on the contact with sediments. This situation suggests a role of mechanical and geochemical barrier as a key factor for U-Mo precipitation in tectonic and lithological structures.

The presented genetic model operates with a series of step-by-step leaching and precipitation processes which resulted to the present-day appearance of the deposit. About 200 Ma ago, percolating ground waters had invaded into the uppermost parts of buried HTC and started to leach U-Mo out of rhyolitic rocks of the upper Grúň Rhyolite Complex. In the deeper parts of the rock complex, the uranium bearing waters interacted with evaporite and phosphorite bearing beds. Such interaction integrated the U-P-Pb-Mo-S geochemical streams, changed water composition ($pH < 4–5$; $Eh > 0$), thus enabling transport of $UO_2(H_2PO_4)_2^0$ or $UO_2HPO_4^0$ complexes. As water stream proceeded through subvertical fault aqueduct, continual reduction responded to molybdenite precipitation and separation of Mo-S/U-P-Pb streams. The main stage of the ore precipitation is related to alteration of infiltrated metamorphosed rocks synchronically with continual deformation of HVC. The reduction and increasing pH during alteration destabilized the dissolved U-Mo complexes and initiated the uraninite – coffinite precipitation.

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